

**5.3/5.8 GHz Dual Band Spread Spectrum**

**Broadband Wireless Internet Access**

**Subscriber Unit (SU) Series**

**Models:   M5830S-SU  
              M5830S-SU-EXT**

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<b>ENGINEERING:</b>	<b>MARKETING:</b>
<b>DATE:</b>	<b>DATE:</b>

**1.0 SUMMARY**

This document details the functional and parametric requirements for the subscriber unit (SU) transceiver which, when setup in a cell having at least one access point (AP), functions as a wireless MAC layer Ethernet access solution. Each SU communicates with a unique AP using 5.3 and 5.8 GHz spread spectrum technology. The SU accepts full or half duplex Ethernet IEEE 802.3 data packets from a 10/100BaseT port, breaks the packets into smaller packets, and transmits them at 11 Mbit/sec rate over the air. Figure 1 shows the block diagram of the unit and the major signals used. The Subscriber Unit product consists of the following:

- 1 subscriber unit (SU) with
  - o Integrated patch antenna (-SU)
  - o External RP SMA Ports (-SU-EXT)
- 1 Pole/wall mount kit
- 1 Junction Box for power injection
- 1 Power adapter

## **2.0 FUNCTIONAL REQUIREMENTS**

The paragraphs below describe the functional requirements of the transceiver.

### **2.1.1 GENERAL REQUIREMENTS**

The unit shall be designed to be compliant with FCC part 15.247/15.407 intentional radiator requirements for a point to point system, and 15.109 unintentional radiator requirements. This requirement specifies certain maximum RF power output and spurious emissions levels.

The unit shall be designed for installation by a professional installer or the end customer.

### **2.1.2 HARDWARE REQUIREMENTS**

#### **2.1.2.1 User Controls and Indicators**

##### **2.1.2.1.1 LEDs**

LED operational requirements are given below. It should be noted, however, that in "Survey" mode, no LEDs shall light up except the LNKST and ACTST LEDs. The unit shall have LED indicators to indicate the following:

##### **a) LNKST LED**

Green: Flashes with Ethernet port activity (LNKST)

##### **b) ACTST LED**

Green: Receive/Transmit Status (ACTST)

##### **c) RSSI LED**

In all modes except "Survey", the unit shall have one yellow LED that indicates the level of RF signal being received and blinks faster with increasing signal strength and slower with less signal strength. If no signal is detected the LED will not blink at all. The level of the signal must be above -80 dBm to start the blinking. At -65 dBm the LED shall go solid.

The LED shall be controlled by the FPGA and is based upon the Prism RSSI register, which indicate the energy level on the antenna.

#### d) Transmit LED

In all modes except "Survey", this red LED shall light up for 300 milliseconds whenever the unit transmits a packet over the RF link and the CPU receives end of transmit confirmation from the FPGA. It shall be set by the CPU and routed through the FPGA.

#### e) Receive LED

In SU mode, this green LED shall blink for 300 milliseconds whenever the unit receives a good (checksum passed) data packet across the RF link from the correct base station. It shall be set by the CPU and routed through the FPGA.

In "AP SEARCH" mode, the LED shall blink when the SU receives a payload packet addressed to any SU.

### 2.1.2.1.2 Connectors

The unit shall have a connector for a 10/100 Base T shielded twisted pair (STP) interface cable connection.

The unit shall have a right angle connector for a serial terminal (Console) connection.

The unit shall be powered using the unused twisted pair wires.

### 2.1.2.2 Power Input

The unit shall have provisions to operate from an unregulated DC power supply.

This input shall be reverse voltage polarity protected and have filtering to prevent damage from static caused by typical nearby lightning strikes and the human body ESD model.

The unit shall have automatically resetting fusing provisions in the event of an over current condition.

### 2.1.2.3 Digital Section

Figure 2 shows the digital subsystem block diagram.

#### 2.1.2.3.1 Microprocessor Subsystem

The unit shall utilize a 32 bit RISC microprocessor to accomplish the requirements in the software section. The subsystem shall consist of the following hardware functions:

- 1) 32 Bit Microprocessor with SDRAM controller
- 2) Ethernet PHY interface
- 3) RS232 Serial port for administration
- 4) Nonvolatile, writeable FLASH Memory 512Kbytes
- 5) SDRAM 8 Mbytes

#### **2.1.2.3.2 Field Programmable Gate Array (FPGA)**

A field programmable gate array shall be used to accomplish the following functions:

- 1) 32 bit wide, 256 long word deep, full duplex FIFO for RF MAC packet transfer to and from the microprocessor subsystem to the radio section Baseband Processor (BBP)
- 2) Microprocessor subsystem data bus interface for transferring data between the microprocessor and the FPGA
- 3) Shift register for to convert RF MAC packets going between the FIFO and the BBP from parallel to serial format.
- 4) PLL programming for IF and RF local oscillators.
- 5) TX/RX switch processing.
- 6) BBP register read/write
- 7) JTAG interfacing to test equipment
- 8) Ranging response processing
- 9) Polling response processing
- 10) Timer to support CPU
- 11) RSSI LED support
- 12) Antenna switch control (polarization)
- 13) Band Switching Control

#### **2.1.2.3.3 Baseband Processor (BBP), Modulator and Demodulator**

The unit shall use the Intersil Prism II chipset solution for modulating and demodulating RF MAC layer packets onto the RF channel. The portion of the chipset that shall be used consists of the BBP and the Quadrature Modulator/Demodulator.

Functions of the solution that shall be utilized:

- 1) Data Transmit
- 2) Data Receive
- 3) Data scrambling.
- 4) IF AGC
- 5) Received Signal Strength monitoring
- 6) Clear Channel Assessment.
- 7) RF power output adjustment

#### **2.1.2.4 RF/Analog Section**

The unit RF section shall be designed as a half duplex transceiver.

The unit shall use a single-conversion receiver architecture.

The unit shall have provisions for multilevel power control at the IF to mitigate the near-far problem encountered during subscriber setup.

The unit shall have provisions for sending accurate signal strength measurement to the microprocessor and gate array.

#### **2.1.2.5 Packaging/Mounting**

The packaging shall be designed for outdoor operation in 100 % humidity conditions.

The packaging shall be designed for outdoor pole or wall mounting with grounding provisions.

The packaging shall be designed to comply with EMC standards as noted in the parametric specifications section.

### **2.1.3 SOFTWARE REQUIREMENTS**

The software requirements outlined herein pertain to the 32 bit RISC microprocessor section only.

#### **2.1.3.3 Bootstrap Load Program**

The bootstrap load program shall wait for 5 seconds after power on to load the Gate Array and upgrade the firmware from the serial port. After 5 seconds the bootstrap will load the current firmware into SDRAM and transfer control to the main program.

#### **2.1.3.4 Real Time Multi-tasking Operating System (RTOS)**

The operating system (kernel) is the lowest layer program that always runs in the microprocessor. It shall allocate system resources to all functions that are covered in this section.

The realtime kernel shall have the following features and functions:

##### **2.1.3.4.3 Cooperative Scheduler**

Cooperative based upon unique task priority, round robin on equal priority.

##### **2.1.3.4.4 Realtime Interrupt handler**

Time critical tasks such as the FIFO management are handled by interrupt control.

##### **2.1.3.4.5 Multitasking capability.**

The ability to run multiple tasks by context switching. The minimum time slice is 1 millisecond.

#### 2.1.3.4.6 Dynamic Memory Allocation.

### 2.1.3.5 Administrator Interface

This section covers the Administrator interface that shall be implemented over the serial port (if connected to a terminal emulator such as Hyperterminal) or via the SU LAN connection. The terminal settings shall be 9600 N-8-1. These settings shall be password protected.

#### 2.1.3.5.3 Firmware version (Read only)

Displays the firmware version currently loaded. Available via serial port and AP LAN connection.

#### 2.1.3.5.4 Firmware Update (Write only)

Allows updating of the firmware locally by serial port or remotely through the access point.

Available via serial port and AP LAN connection.

#### 2.1.3.5.5 Connection Status (Read only)

Displays the local Station ID(assigned by AP) ,MAC address, and association status with the AP. Available via serial port and LAN connection.

#### 2.1.3.5.6 RF Channel/Polarization Assignment (Read/Write)

Displays the current channel/polarization and prompts for the following two options:

- 1) Automatic assignment from Access Point (default). The unit automatically scans all channels and polarizations (loaded using the "writescan" command) sequentially for a valid access point, then transfers channel control to the access point after communication has been made. If no communication with the access point is made or is lost, the unit will continue to scan for a valid access point.
- 2) Manual Assignment of channel/polarization. Forces the unit to a channel. Use with caution.

Available via serial port and LAN connection.

#### 2.1.3.5.7 RF Power level manual override (Read/Write)

Displays the current RF power level as set by the Access Point and prompts for the following two options:

- 1) Automatic setting of power from Access Point (default)
- 2) Manual setting of power. This mode should be used with caution since higher power levels may cause interference problems with other subscribers.

Available via serial port and LAN connection.

#### 2.1.3.5.8 Received Signal Strength (Read only)

Displays the received signal strengths in dBm of all received transmissions from the AP over a user selectable period in seconds. It shall listen on all available channels on each polarization

Available via serial port and LAN connection.

#### 2.1.3.5.9 Site Survey Mode (Read only)

This function monitors each channel for a time from 30 seconds to 24 hours and displays the following information:

- 1) Max Signal Strength on each channel/polarization.
- 2) Average Signal Strength on each channel/polarization.
- 3) Valid Access Point (AP) ID numbers found on each channel/polarization and corresponding average signal strength of AP.

The unit will be offline when this mode is active. This function is only available via the serial port.

#### 2.1.3.5.10 MAC Layer filtering control

This command shall allow the user to enable/disable MAC layer broadcast (except ARP), multicast packets from being sent through the link.

### 2.1.3.6 Communication Protocols for Ethernet Packets

The subscriber unit shall treat all data arriving at the Ethernet port as data to be transferred across the wireless link to the AP. In essence the SU shall function as a repeater. (Note for manual: If the end user wishes to free up more air time, packet filtering via a router, switch or similar should be done before the data enters the SU.)

#### 2.1.3.7 Smart Polling Protocol

The unit shall be a remote terminal in a star configuration wireless multipoint network supporting up to 512 subscriber units. The functional description of the protocol is as follows:

The AP unit acts as a hub in a star configuration wireless multipoint network supporting up to 512 subscriber units. The functional description of the protocol is as follows:

The AP unit, hardwired to a Point of Presence, polls each subscriber unit SU in a round robin format to determine if the SU has data to transfer. The SU only transmits the data "upstream" to the AP when the AP gives authorization via a transmit grant. The SU parses every "downstream" data packet from the AP and identifies packets intended for it.

Normally the administrator will first add the MAC address and ID number of the SU to the user database of the AP with which the SU will associate. Then, the SU will be installed by a technician at the subscriber premises.

When power is first applied to the SU, it will scan all the channels in its scantable, searching for an AP that is sending transmit grants for the SU. The SU will then stop on that channel and respond to the AP using maximum RF power. Before the AP can add the SU to the polling list, it must authenticate the SU by verifying the MAC address, and performing a ranging operation to the SU. This process involves sending a special command to the SU and getting an instantaneous reply from the SU.

Upon successfully locating and ranging the SU, The AP will then add the SU to the normal polling list and level the RF transmit power level from the SU to set a good signal-to- noise ratio at the AP.

The AP uses several parameters to determine how often each SU is polled for data, and the conditions of any data transfer, as follows:

- 1) Committed Information Rate (CIR)
- 2) Maximum Information Rate (MIR)
- 3) Priority
- 4) Poll response timeout

All the above parameters are set in the AP by the system administrator and cannot be controlled at the SU.



## 3.0 PARAMETRIC REQUIREMENTS

### 3.1 TRANSMITTER SECTION

#### Radio Section

Frequencies:

Storable Channels: 30 memory locations  
Channel spacing: Low Band: 5.260 to 5.340 GHz in 1 MHz increments  
High Band: 5.736 to 5.836 GHz in 1 MHz increments  
Default Channels-  
Channel 1: 5.736 GHz  
Channel 2: 5.756 GHz  
Channel 3: 5.776 GHz  
Channel 4: 5.796 GHz  
Channel 5: 5.816 GHz  
Channel 6: 5.836 GHz  
Channel 7: 5.260 GHz  
Channel 8: 5.280 GHz  
Channel 9: 5.300 GHz  
Channel 10: 5.320 GHz  
Channel 11: 5.340 GHz  
Channels 12-30: Unprogrammed

RF Conducted Power: SU: Low Band: Max: +13 dBm +/- 2 dB  
Min: -8 dBm +/- 2 dB

SU-EXT: Low Band: Max: +6 dBm +/- 2 dB  
Min: -8 dBm +/- 2 dB

All models High Band: Max: +22 dBm +/- 2 dB  
Min: -8 dBm +/- 2 dB

EIRP Max: +40 dBm High band with internal 18 dBi patch antenna (-SU)  
+45 dBm High band with 24 dBi DSS dish or Patch (-SU-EXT)  
+48 dBm High band with 27 dBi DSS dish (-SU-EXT)  
+49 dBm High band w/28 dBi dish (-SU-EXT with SPD2-5.2)  
+52 dBm High band w/31 dBi dish (-SU-EXT with SPD3-5.2)  
+55 dBm High band w/34 dBi dish (-SU-EXT with SPD4-5.2)  
+30 dBm Low band Maximum with all antenna configurations  
(professional install required)

Freq. Stability: .00025 % PLL Stabilized (2.5 ppm) over temp  
Freq. Plan: Single upconversion, 480 MHz IF  
Modulated BW: 22 MHz (null to null, 20 dB)  
2<sup>nd</sup> Harmonic atten: Per CFR47 part 15.205  
LO Supression: Per CFR47 part 15.205  
Symbol Rate: 1.375 MSPS

Error Correction: None  
Modulation: 1 MBPS DBPSK for header, 11 MBPS CCK spread spectrum for payload

#### **Data Input Section**

Data Rate (User): Up to 10 MBPS Sustained throughput  
Format: 10/100 BaseT IEEE 802.3 Ethernet compliant  
Ethernet packet: Up to 1600 byte long packets

#### **Power**

Input Voltage: Input voltage range at unit is 10.5 VDC to 24 VDC max  
Power is supplied on Ethernet cable using junction box provided with up to 330 foot 24 AWG STP cable.

Current Cons.: 575 mA in transmit mode at max power using 20 V standard adapter (11.5W)  
500 mA in receive mode using 20 V standard adapter (10 W)

### **3.2 RECEIVER SECTION**

#### **Radio Section**

Frequencies:

Storable Channels: 30 memory locations  
Channel spacing: Low Band: 5.260 to 5.340 GHz in 1 MHz increments  
High Band: 5.736 to 5.836 GHz in 1 MHz increments  
Default Channels-  
Channel 1: 5.736 GHz  
Channel 2: 5.756 GHz  
Channel 3: 5.776 GHz  
Channel 4: 5.796 GHz  
Channel 5: 5.816 GHz  
Channel 6: 5.836 GHz  
Channel 7: 5.260 GHz  
Channel 8: 5.280 GHz  
Channel 9: 5.300 GHz  
Channel 10: 5.320 GHz  
Channel 11: 5.340 GHz  
Channels 12-30: Unprogrammed

Cascade Noise Figure: < 6 dB  
Sensitivity: - 83 dBm typical-1600 byte packet  
(1E10-6 BER) - 87 dBm typical-64 byte packet  
Adj. Channel Rejection: > +20 dB for 10 % PER  
Image Rejection: > +60 dB for 10% PER  
Frequency Plan: Single conversion, IF at 480 MHz

LO stability: .00025% PLL stabilized (+/-2.5ppm) over temperature range  
Input compression point: > -15 dBm P1dB

#### Data Output Section

Data Rate (User): 10 MBPS Maximum sustained throughput  
Format: 10/100 BaseT IEEE 802.3 Ethernet compliant  
Ethernet Protocols: TCP/IP, Telnet, TFTP, UDP, HTTP

### 3.3 MECHANICAL AND ENVIRONMENTAL

#### General

Material: Powdercoated Aluminum base with polycarbonate radome  
Size: 12.5"x5"x8" including mounting studs  
Weight: 4 lb  
Mounting: Custom mounting bracket with azimuth-elevation adjustment.

#### Connectors/Indicators

RF Output: -SU: Integral internal patch antenna per Part 15C, 15.203.  
-SU-EXT: Reverse Polarity SMA per Part 15C, 15.203

#### FCC Compliance:

The transceiver shall comply with the following regulations:

FCC 15.247 Spread Spectrum transmitter - 5.725 to 5.85 GHz - EIRP = unlimited  
FCC 15.407(2) U-NII Band 2 transmitter - 5.25 to 5.35 GHz - EIRP = 30 dBm max

Subpart B  
Class B Digital device verification

Subpart C  
FCC 15.203 Antenna connection requirement - non-standard connection  
FCC 15.209 Unwanted emissions below 1GHz -  
FCC 15.207(a) AC conducted emissions 450Khz to 30 MHz  
FCC 15.205 Restricted bands of operation (LO and harmonics) - 54 dBuV @3 meters

Serial Interface: Shielded RJ11 connector  
LAN Interface: Shielded RJ45 connector  
Power: Carried on 4 unused pins of Ethernet cable

#### Environmental

Operating Temp: -40 to 60 deg C  
Storage: -40 to 85 deg C  
Humidity: 100 % When sealed properly  
NEMA Rating: NEMA 4  
Shock: Sustain 3 axis drop from 5 feet

### 3.4 STANDARD EXTERNAL POWER SUPPLY

20 Volt DC Power adapter and J-Box supplied with product.

Type:	Linear wall mount transformer
Input:	120 VAC
Output:	20 VDC +/- 1 V
Max current:	1200 mA

### 3.5 STANDARD ANTENNA FOR SU (PATCH ARRAY)

Type:	Patch Array Antenna
Polarization:	Vertical, Horizontal electrically selectable
Frequency:	5.2 to 5.9 GHz
Gain:	+17 +/- 1 dBiL (Low Band) +18 +/- 1 dBiL (High Band)
Az Beamwidth:	18 degrees (3 dB down)
El Beamwidth:	10 degrees (3 dB down)
Cross Pol:	>20 dB
Front/Back:	>30 dB

### 3.6 STANDARD ANTENNA FOR M5830S-SU-EXT (model AD5830-24-D)

The unit is designed to operate with the Trango Boadband model AD5830-24-D dual linear polarized dish antenna.

Type:	18" DSS Style Dish Antenna
Polarization:	Vertical, Horizontal electrically selectable
Frequency:	5.7 to 5.9 GHz
Gain:	+24 dBi
Az Beamwidth:	9°
El Beamwidth:	9°
Cross Pol:	> 15dB
Front/Back Ratio:	> 30dB
VSWR:	2:1
Wind Loading:	80 mph operational

### 3.7 Optional PATCH Antenna for SU-EXT

Frequency range:	5250-5850 MHz
Gain:	23 dBi +/- 1 dB
Front/Back Ratio	>35 dB
E-Plane Beamwidth:	> 9 degrees typical
H-Plane Beamwidth:	> 9 degrees typical
Polarization:	Vertical and Horizontal
Port/Port Isolation:	40 dB typ
Cross Pol Rejection:	25 dB typ
VSWR:	<1.7:1
Package:	Aluminum backplate with plastic radome.
Dimensions:	14.6"x 14.6"x 1.58" (371mm x 371mm x 40mm)
Weight:	5.5 lbs (2.5 kg)
Connector:	SMA female connectors (2)
Cable:	24" SMA-M to SMA-RP double braided RGS142 cable
Mounting Provisions:	Mounting kit supplied for up to 3" diam pole or flat surface
Azimuth/EI Adjust:	+/-30 degrees
Sealing:	Water tight to 1 meter IEC 529/IP67
Temp Range:	-40 deg F to +160 deg F (-40 deg C to +60 deg C)
Wind speed operational:	100 mph (160 km/hr)
Wind speed survival:	140 mph (220 km/hr)

### 3.8 Optional 3' DIAM PRIME FOCUS DISH ANTENNAS FOR SU-EXT

#### Radiowaves, Inc. Model: SPD3-5.2

Frequency range:	5250-5850 MHz
Gain:	30 dBi +/- 1 dB
Front/Back Ratio	>38 dB
E-Plane Beamwidth:	> 4.2 degrees typical
H-Plane Beamwidth:	> 4.2 degrees typical
Polarization:	Vertical and Horizontal
Cross Pol Rejection:	30 dB typ
VSWR:	<1.5:1
Diameter:	3 feet
Weight:	35 lbs
Mounting:	Pole Mount

## APPENDIX A

## HARDWARE CHANGE HISTORY

<u>Product/Rev</u>	<u>Change Description</u>	<u>FFF Chg?</u>
M5830S-SU rev 1 M5830S-SU-EXT rev 1	- Baseline	